Refresher: The Importance of Energy Codes

- Most states and local jurisdictions adopt building energy codes to establish the minimum legal standards for building construction – including fenestration efficiency.
- Energy codes generally establish requirements for new buildings, additions & remodeling and replacement windows.
- Most jurisdictions adopt national model codes, occasionally with local amendments.
Federal Law Requires States to Consider and/or Adopt Model Energy Codes

• For almost two decades, federal law has required states to consider and/or adopt national model energy codes:
  o Residential construction = IECC
  o Non-residential construction = IECC and ASHRAE 90.1
2018 IECC/IRC and ASHRAE 90.1-2016 are the Most Recent National Model Energy Codes

• 2018 IECC contains separate, stand-alone residential & commercial (including high-rise residential) energy codes.
• 2018 IRC (International Residential Code) Chapter 11 also contains the IECC residential energy provisions.
• ASHRAE 90.1-2016 establishes an alternative compliance option for high-rise residential and non-residential.
Model Code Improvement

• An extraordinary surge in code efficiency levels has been seen in the past 10 years for both residential and commercial buildings.
• Fenestration has played a major role in driving increased energy savings under the codes.
• Increased stringency in fenestration code requirements has led to significant market changes.
IECC - Residential

- The 2009 and 2012 residential IECC requirements incorporated big increases in efficiency. The 2015 and 2018 IECC consolidated and fine-tuned these gains.

- 2015 IECC reorganized existing building requirements in both residential and commercial chapters.

- 2015 IECC also added new Energy Rating Index (ERI) compliance method for residential buildings, reflective of the RESNET HERS rating system. The 2018 IECC refined this method further.
Improved Residential Efficiency Requirements in the 2012, 2015 and 2018 IECC

- DOE studies have concluded that:
  - 2012 IECC saves between 25% and 38% in relevant energy costs over the 2006 IECC, depending on climate zone.
  - 2015 IECC saves about 1% over the 2012 IECC.
  - DOE found 2012 and 2015 IECC cost-effective in every state analyzed.

- 2018 IECC is expected to be found by DOE to be slightly more efficient than 2015 IECC.
Residential Code Improvement

Source: Building Codes Assistance Project
Improved Residential Fenestration Requirements in the 2012, 2015 and 2018 IECC

• Each new version of the code specifies even more efficient fenestration in virtually all climate zones.

• Efficient low-e windows have become the universal product and low solar low-e is required in climates with significant cooling needs.
Residential IECC: Prescriptive Maximum Window U-Factor Continues to Improve

<table>
<thead>
<tr>
<th>Zone</th>
<th>2006 IECC</th>
<th>2009 IECC</th>
<th>2012/2015 IECC</th>
<th>2018 IECC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 2</td>
<td>0.75</td>
<td>0.65</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Zone 3</td>
<td>0.65</td>
<td>0.50</td>
<td>0.35</td>
<td>0.32</td>
</tr>
<tr>
<td>Zone 4</td>
<td>0.40</td>
<td>0.35</td>
<td>0.35</td>
<td>0.32</td>
</tr>
<tr>
<td>Zones 5-8</td>
<td>0.35</td>
<td>0.35</td>
<td>0.32</td>
<td>0.30</td>
</tr>
</tbody>
</table>
Residential IECC: Prescriptive Maximum Window SHGC in Certain Climate Zones Also Improves

<table>
<thead>
<tr>
<th>Climate Zones</th>
<th>2006 IECC</th>
<th>2009 IECC</th>
<th>2012/2015/2018 IECC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate Zones 1 through 3</td>
<td>0.40</td>
<td>0.30</td>
<td>0.25</td>
</tr>
<tr>
<td>Climate Zone 4 Except Marine</td>
<td>NR</td>
<td>NR</td>
<td>0.40</td>
</tr>
</tbody>
</table>
IECC Commercial

Like the residential energy code, the commercial energy code requirements in the IECC and ASHRAE 90.1 have seen substantial efficiency increases over the past 10 years.
Commercial Code Improvement

Source: Building Codes Assistance Project
2018 IECC – Commercial Fenestration

• The 2012 IECC fenestration requirements were substantially simplified and made frame-material neutral. The 2015 and 2018 IECC maintain objective, frame-material neutrality.

• Fenestration U-factors are based on three categories: Fixed, Operable and Entrance Door (skylights are addressed separately).

• Prescriptive table allows:
  o 30% window to wall ratio
  o Up to 40% window to wall ratio permitted if daylighting provisions are satisfied

• 2015 and 2018 IECC clarify that all replacement fenestration must meet the same efficiency requirements as fenestration in new construction.

• Minimum requirements for skylights are established for certain buildings.
## 2012 / 2015 / 2018 IECC
### Commercial Fenestration U-factors

<table>
<thead>
<tr>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
<th>Zone 4 Except Marine</th>
<th>Zone 5 &amp; Marine 4</th>
<th>Zone 6</th>
<th>Zone 7</th>
<th>Zone 8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed Fenestration U-Factor</strong></td>
<td>0.50</td>
<td>0.50</td>
<td>0.46</td>
<td>0.38</td>
<td>0.38</td>
<td>0.36</td>
<td>0.29</td>
</tr>
<tr>
<td><strong>Operable Fenestration U-Factor</strong></td>
<td>0.65</td>
<td>0.65</td>
<td>0.60</td>
<td>0.45</td>
<td>0.45</td>
<td>0.43</td>
<td>0.37</td>
</tr>
<tr>
<td><strong>Entrance Door U-Factor</strong></td>
<td>1.10</td>
<td>0.83</td>
<td>0.77</td>
<td>0.77</td>
<td>0.77</td>
<td>0.77</td>
<td>0.77</td>
</tr>
<tr>
<td><strong>Skylights U-Factor</strong></td>
<td>0.75</td>
<td>0.65</td>
<td>0.55</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
</tbody>
</table>
2012 IECC – Commercial Fenestration: Simplified Approach to SHGC

- Simple, single set of maximum SHGC values by product type.
- Separate table with SHGC projection factor multipliers if desired (C402.3.3.1).

<table>
<thead>
<tr>
<th></th>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
<th>Zone 4 Except Marine</th>
<th>Zone 5 &amp; Marine 4</th>
<th>Zone 6</th>
<th>Zone 7</th>
<th>Zone 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Fenestration SHGC</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>Skylights SHGC</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>
2015/2018 IECC – Commercial Fenestration: SHGC by Projection Factor and Orientation

- 2015/2018 IECC added complexity; required prescriptive maximum SHGC values vary by Projection Factor and Orientation for each climate zone.
- Each climate zone now has 6 different SHGC requirements (2018 CZ5 example below):

<table>
<thead>
<tr>
<th>Orientation</th>
<th>SEW</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF &lt; 0.2</td>
<td>0.38</td>
<td>0.51</td>
</tr>
<tr>
<td>0.2 ≤ PF &lt; 0.5</td>
<td>0.46</td>
<td>0.56</td>
</tr>
<tr>
<td>PF ≥ 0.5</td>
<td>0.61</td>
<td>0.61</td>
</tr>
</tbody>
</table>
2015 IECC – Commercial
SHGC by Projection Factor and Orientation

• Base maximum SHGC values (PF<0.20; SEW orientation) remain the same as 2012.
• To simplify compliance, a maximum 0.25 SHGC will continue to comply everywhere for all orientations.
• Similarly, for 2015 a 0.40 SHGC continues to comply in climate zone 4 and higher; and a 0.45 SHGC continues to comply in climate zones 7-8.
• As an alternative, SHGCs that vary by orientation and PF for each fenestration can be specified.
## 2018 IECC – Commercial

**SHGCs Reduced in Certain Climates**

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>4 except Marine</th>
<th>5 and Marine 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Orientation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEW</td>
<td>0.40 0.36</td>
<td>0.40 0.38</td>
</tr>
<tr>
<td>N</td>
<td>0.53 0.48</td>
<td>0.53 0.51</td>
</tr>
<tr>
<td><strong>PF &lt; 0.2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEW</td>
<td>0.48 0.43</td>
<td>0.48 0.46</td>
</tr>
<tr>
<td>N</td>
<td>0.58 0.53</td>
<td>0.58 0.56</td>
</tr>
<tr>
<td><strong>0.2 ≤ PF</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEW</td>
<td>0.64 0.58</td>
<td>0.64 0.61</td>
</tr>
<tr>
<td>N</td>
<td>0.64 0.58</td>
<td>0.64 0.61</td>
</tr>
<tr>
<td><strong>PF ≥ 0.5</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEW</td>
<td>0.64 0.58</td>
<td>0.64 0.61</td>
</tr>
<tr>
<td>N</td>
<td>0.64 0.58</td>
<td>0.64 0.61</td>
</tr>
</tbody>
</table>
2018 IECC – Commercial SHGC by Projection Factor and Orientation

- Base maximum SHGC values for CZ4 and CZ5 (PF<0.20; SEW orientation) are lower than 2015.
- To simplify, 0.25 SHGC will continue to comply everywhere for all orientations.
- A 0.36 SHGC will continue to comply in climate zone 4 and higher; and a 0.45 SHGC will continue to comply in climate zones 7-8.
- As an alternative, SHGCs that vary by orientation and PF for each fenestration can be specified.
ASHRAE 90.1-2016

- US DOE issued a final determination on ASHRAE 90.1-2016 on February 27, 2018 (finding, on average, a 6% to 8% improvement over the 2013 version).
- Within two years, States must certify that commercial energy codes meet or exceed ASHRAE 90.1-2016
- Although federal law specifies ASHRAE 90.1 as the benchmark, states commonly adopt the IECC for both residential and commercial construction (since ASHRAE 90.1 is an option under the IECC, this is generally considered sufficient).
- Unlike the IECC, ASHRAE 90.1-2016 retains material differences (different requirements for metal vs. non-metal frames) in fenestration requirements.
## ASHRAE 90.1-2016 Update: Reduced Fenestration U-Factors

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Nonmetal Framing</th>
<th>Metal Framing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>U-Factor</td>
<td>U-factor</td>
</tr>
<tr>
<td>0</td>
<td>0.32</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>0.35</td>
<td>0.33</td>
</tr>
<tr>
<td>4</td>
<td>0.35</td>
<td>0.31</td>
</tr>
<tr>
<td>5</td>
<td>0.32</td>
<td>0.31</td>
</tr>
<tr>
<td>6</td>
<td>0.32</td>
<td>0.30</td>
</tr>
<tr>
<td>7</td>
<td>0.32</td>
<td>0.28</td>
</tr>
<tr>
<td>8</td>
<td>0.32</td>
<td>0.25</td>
</tr>
</tbody>
</table>
ASHRAE 90.1-2016 Update: Fenestration SHGC Reduced

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>90.1-2013 SHGC</th>
<th>90.1-2016 SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-</td>
<td>0.22</td>
</tr>
<tr>
<td>1</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>2</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>4</td>
<td>0.40</td>
<td>0.36</td>
</tr>
<tr>
<td>5</td>
<td>0.40</td>
<td>0.38</td>
</tr>
<tr>
<td>6</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>7</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>8</td>
<td>0.45</td>
<td>0.45</td>
</tr>
</tbody>
</table>
ASHRAE 90.1-2016 Update: Fenestration SHGC

• Orientation-specific window area requirements (related to SHGC) in prescriptive path (5.5.4.5).

Two main options (with some exceptions) for meeting fenestration requirements in ASHRAE 90.1-2016

• Option A: (For all climate zones)
  o West-facing fenestration area is ≤25% of total fenestration area and
  o East-facing fenestration area is ≤25% of total fenestration area
ASHRAE 90.1-2016 Update: Fenestration SHGC

• Option B: (For climate zones 0-3)
  o W-facing fenestration area X W-facing SHGC ≤25% of total fenestration area X prescriptive SHGC and
  o E-facing fenestration area X E-facing SHGC ≤25% of total fenestration area X prescriptive SHGC

• Option B: (For climate zones 4-8)
  o W-facing fenestration area X W-facing SHGC ≤20% of total fenestration area X prescriptive SHGC and
  o E-facing fenestration area X E-facing SHGC ≤20% of total fenestration area X prescriptive SHGC

• Effect of Option B is to allow more West- and East-Facing Glazing with lower SHGCs.
ASHRAE is currently considering improvements to its fenestration requirements. The pending proposal includes:

- Material-neutral values consistent with IECC approach
- Improved U-factors and SHGCs
Unprecedented Levels of Adoption of Most Recent Model Energy Codes

• Over the past few years, energy code compliance has become a much more important factor in building design and construction as states have more rapidly adopted and implemented new model codes with more aggressive requirements.

• Vast majority of states have adopted the 2009 IECC and/or ASHRAE 90.1-2007.

• On the residential side, close to half of the states (including the most populated) have now upgraded to meet or exceed the 2012 IECC or 2015 IECC.

• More than half of the states have adopted ASHRAE 90.1-2010 or 90.1-2013 or the equivalent, primarily by adopting the IECC.
Residential Code Status

Source: Building Codes Assistance Project
Commercial Code Status

- Meets or exceeds ASHRAE 90.1-2013 or equivalent (12)
- Meets or exceeds ASHRAE 90.1-2010 or equivalent (17)
- Meets or exceeds ASHRAE 90.1-2007 or equivalent (15)
- Meets or exceeds ASHRAE 90.1-2004 or equivalent (1)
- No statewide code or predates ASHRAE 90.1-2004 (11)

Source: Building Codes Assistance Project
NFRC Role in Energy Codes

- Modern model energy codes incorporate NFRC procedures as the exclusive method for determining fenestration energy performance for both residential & non-residential construction (U-factor, SHGC, VT).
- The only alternative is a limited default table.
- Virtually all state codes currently incorporate these requirements.
- Code requirements have been an incredibly important driver of NFRC labeling, particularly by the residential window industry.
IECC Requirement for NFRC Ratings – Section 303.1.3

• U-factor or SHGC:
  o Must be “determined in accordance with NFRC 100 [or 200]”
  o Must be “determined by an accredited, independent laboratory”
  o Must be “labeled and certified by the manufacturer.”
  o The word “labeled” is defined in IECC Ch. 2 as products:
    • “to which have been affixed a label, seal, symbol, or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with production evaluation ....”
    • “that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates ... that the product meets identified standards ....”
**Limited Fenestration Defaults: U-Factor**

- Products lacking labeled and certified NFRC ratings are assigned a default value, with no credit for key attributes like low-e.

<table>
<thead>
<tr>
<th>Frame Type</th>
<th>Single Pane</th>
<th>Double Pane</th>
<th>Skylight Single</th>
<th>Skylight Double</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal</td>
<td>1.20</td>
<td>0.80</td>
<td>2.00</td>
<td>1.30</td>
</tr>
<tr>
<td>Metal with Thermal Break</td>
<td>1.10</td>
<td>0.65</td>
<td>1.90</td>
<td>1.10</td>
</tr>
<tr>
<td>Nonmetal or Metal Clad</td>
<td>0.95</td>
<td>0.55</td>
<td>1.75</td>
<td>1.05</td>
</tr>
<tr>
<td>Glazed Block</td>
<td></td>
<td></td>
<td>0.60</td>
<td></td>
</tr>
</tbody>
</table>
Limited Fenestration Defaults: SHGC & VT

- Products lacking labeled and certified NFRC ratings are assigned a default value, with no credit for key attributes like low-e.

<table>
<thead>
<tr>
<th></th>
<th>SINGLE GLAZED</th>
<th>DOUBLE GLAZED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clear</td>
<td>Tinted</td>
</tr>
<tr>
<td>SHGC</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>VT</td>
<td>0.6</td>
<td>0.3</td>
</tr>
</tbody>
</table>
2016 California Building Energy Efficiency Standards

- Adopted: August 12, 2015
  Effective Date: January 1, 2017

- Window performance requirements for residential and nonresidential are the same in the 2013 and 2016 Standards.

- Increased stringency in other parts of the 2016 residential code means that better performing windows provide builders the opportunity to trade-off some of the increased stringency.
2016 California Building Energy Efficiency Standards – Residential
Prescriptive Requirements

• Strong fenestration prescriptive criteria:
  o Maximum 0.32 U-factor for all of California.
  o Maximum 0.25 SHGC for almost all of California.
  o The prescriptive path is also the baseline for the performance method.
2016 California Building Energy Efficiency Standards – Nonresidential Requirements

- Strong nonresidential fenestration prescriptive criteria:
  - Minimum VT requirement
  - Maximum U-factor and SHGC values
  - Same values across entire state
  - Material-neutral vertical fenestration requirements.

- The prescriptive path is also the baseline for the nonresidential performance method.
# 2016 California Building Energy Efficiency Standards -- Nonresidential Fenestration Prescriptive Values

<table>
<thead>
<tr>
<th>Vertical Fenestration (Max 40% WWR)</th>
<th>Fixed Window</th>
<th>Operable Window</th>
<th>Curtainwall / Storefront</th>
<th>Glazed Doors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max U-Factor</td>
<td>0.36</td>
<td>0.46</td>
<td>0.41</td>
<td>0.45</td>
</tr>
<tr>
<td>Max RSHGC</td>
<td>0.25</td>
<td>0.22</td>
<td>0.26</td>
<td>0.23</td>
</tr>
<tr>
<td>Min VT</td>
<td>0.42</td>
<td>0.32</td>
<td>0.46</td>
<td>0.17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skylights (Max 5% SRR)</th>
<th>Glass, Curb Mounted</th>
<th>Glass, Deck Mounted</th>
<th>Plastic, Curb Mounted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max U-Factor</td>
<td>0.58</td>
<td>0.46</td>
<td>0.88</td>
</tr>
<tr>
<td>Max RSHGC</td>
<td>0.25</td>
<td>0.25</td>
<td>NR</td>
</tr>
<tr>
<td>Min VT</td>
<td>0.49</td>
<td>0.49</td>
<td>0.64</td>
</tr>
</tbody>
</table>
• The Manufacturer or an independent certifying agency must certify that the product complies with NFRC 100 or 200 (or use a limited default table).

• Products must have a temporary and permanent label or a label certificate if CMA is used.

• CEC reduced the NFRC site-built exception in 2013:
  - Under the old standards, buildings with 10,000 square feet or less of site-built fenestration did not require NFRC certification and labeling.
  - The current exemption is 1,000 square feet of site-built fenestration.
2019 California Building Energy Efficiency Standards Rulemaking

- Adopted: May 9, 2018
  Effective Date: January 1, 2020
- Increased stringency for residential window performance:
  - Maximum 0.30 U-factor for all of California
  - Maximum 0.23 SHGC for almost all of California (NR in climate zones 1, 3, 5 & 16)
- Glazed doors with 25% or more glass area must meet the requirements for fenestration (was 50% in 2016 Code).
- Like in previous versions, increased stringency in other parts of the residential code means that builders have the opportunity to use more efficient windows as a trade-off.

• Major NFRC Improvement in 2019 Standards:
  o Further reduced the Nonresidential Site-Built NFRC Exemption: Only 200 sf* of nonresidential site-built fenestration will be exempt from NFRC ratings for U-factor, SHGC, and VT (*Lowered from 1,000 sf).
Fenestration Energy Code Compliance in Residential Buildings – Grade: A+

- U.S. DOE conducted field studies and has collected compliance data from several states.
- DOE found remarkably high compliance rates with fenestration U-factors and SHGCs in all states studied.
- NFRC ratings and straightforward, uniform requirements were likely behind this market transformation.
Window SHGC
Fenestration Energy Code Compliance in Commercial Buildings – Grade: Needs Improvement

- Fenestration has an enormous impact on commercial building energy performance with often a far higher percentage of window area than residential.
- While the code requirements are straightforward, actual compliance nationwide apparently is not.
- In evaluating commercial code compliance issues, US DOE has found that the lack of ratings and the documentation of fenestration energy performance ratings to be among the biggest code compliance problems.
- This compliance failure is surprising given the clear mandate for NFRC ratings and the ease in which NFRC ratings can be checked for code compliance (the label certificate, in particular, spells out the certified values for all products in one easy to review document).
DOE Compliance Pilot Study
“Least Compliant”

From Table E.3. Least Compliant Commercial Code Requirements (least compliant first)

- Fenestration and doors labeled for air leakage.
- Fenestration products rated in accordance with NFRC.
- Doors meet maximum air leakage requirements.
- Fenestration meets maximum air leakage requirements.
- Plans and/or specifications provide all information with which compliance can be determined for the
  building envelope and delineate and document where exceptions to the standard are claimed.
- Fenestration products are certified as to performance labels or certificates provided.
- Plans, specifications, and/or calculations provide all information with which compliance can be
determined for the lighting and electrical systems and equipment and delineate and document where exceptions to the standard are claimed. Information provided should include interior and exterior lighting power calculations, wattage of bulbs and ballasts, transformers and control devices.
- Heat traps installed on non-circulating storage water tanks.
- Plans, specifications, and/or calculations provide all information with which compliance can be
determined for the service water heating systems and equipment and delineate and document where exceptions to the standard are claimed. Plans, specifications, and/or calculations provide all information with which compliance can be determined for the service water heating systems and equipment and delineate and document where exceptions to the standard are claimed.
DOE Compliance Pilot Study
“Not Observable”

**From Table E.9. Commercial Code Requirements**
Most Often Marked “Not Observable”

- Fenestration meets maximum air leakage requirements.
- Doors meet maximum air leakage requirements.
- U-factor of opaque doors associated with the building thermal envelope meets requirements.
- Return air and outdoor air dampers meet minimum air leakage requirements.
- Fenestration and doors labeled for air leakage.
- Fenestration products rated in accordance with NFRC.
- Fenestration products are certified as to performance labels or certificates provided.
- Skylight curbs insulated to the level of roofs with insulation above deck or R-5.
- Skylight fenestration U-Factor.
- Reduce flow in pumping systems of any size to multiple chillers or boilers when others are shut down.
- Automatic lighting controls for exterior lighting installed.
NFRC Major Challenge for the Future:

How do we achieve greater code compliance and enforcement utilizing NFRC ratings in high rise residential and commercial buildings?
Disclaimer

Please note that this presentation is not intended as advice, legal or otherwise, and no guarantee is offered as to its accuracy. The applicable version of the code should be consulted carefully for any code requirements or compliance questions. Use of the information in this presentation is entirely at your own risk.